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Anomalous Josephson effect in semiconductor nanowire with strong spin-orbit interaction and Zeeman effect TOMOHIRO YOKOYAMA, Center for Emergent Matter Science (CEMS), RIKEN Institute, MIKIO ETO, Faculty of Science and Technology, Keio University, YULI NAZAROV, Kavli Institute of Nanoscience, Delft University of Technology — We theoretically investigate the Josephson junction using quasi-one dimensional semiconductor nanowires with strong spin-orbit (SO) interaction, e.g., InSb. First, we examine a simple model using a single scatterer to describe the elastic scattering due to impurities and SO interaction in the normal region.[1] The Zeeman effect is taken into account by the spin-dependent phase shift of electron and hole through the system. The interplay between SO interaction and Zeeman effect results in a finite supercurrent even when the phase difference between two superconductors is zero. Moreover, the critical current depends on its current direction if more than one conduction channel is present in the nanowire. Next, we perform a numerical simulation by the tight-binding model for the nanowire to confirm our simple model. Then, we show that a spin-dependent Fermi velocity due to the SO interaction causes the anomalous Josephson effect.

[1]T. Yokoyama, M. Eto, and Yu. V. Nazarov, J. Phys. Soc. Jpn. **82**, 054703 (2013).

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